The New Atlantis
A Journal of Technology & Society

The Unknown Newton

The Strange Tale of Newton's Papers

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When Isaac Newton died on March 31, 1727 at the age of eighty-four, he left no will but a houseful of possessions, a fat bank account, and a clutch of greedy relatives. An inventory of his estate was soon drawn up. Alongside such items as a chocolate pot, mathematical tools, and crimson goat-hair bed furnishings, the document (which filled a sheet of vellum some seventeen feet long) listed boxfuls of manuscripts. Almost 1,900 booklets, many of them folded or sewn to gather four, eight, twelve or more leaves, were bundled and stacked in no apparent order. No list or catalogue itemizing their contents was found.

Even without a list, it was clear that not only the form but the contents of the papers were a mix. There were "reams of loose and foul papers," as their first inheritor put it, on a bewildering variety of topics. Here were the expected notes on natural philosophy and mathematics. But here too were less predictable (and, on closer inspection, less orthodox) writings on the nature of prophecy, the Apocalypse, and on God. Newton had, the papers revealed, spent hours and hours on an extremely detailed history of the early Church. Similarly prodigious reading notes and experimental records showed how much time Newton had spent on alchemical investigation—years, and even decades, from the looks of the notes, rather than only days or months.

Newton had always been wary of sharing his scientific work, but he had kept this non-scientific material more private still. Only a few people had seen just a small portion of it. The rest was known only to Newton himself. This private material showed that he had devoted much of his long life not only to mathematics, physics, and optics, and to the administration of the Royal Mint that he undertook for three decades in London, but also to theological, historical, and alchemical subjects.

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The catalogers facing this unassigned legacy confronted questions that have excited and bedeviled Newton scholars ever since: How could one man have pursued so many, and such disparate, interests? What bearing, if any, did his theological and alchemical investigations have on his scientific work, and vice versa? What was the relationship between Newton's science and his faith? Newton himself was not much help. There is precious little to be found in the papers on the vexed issue of his methods of discovery and how, for example, he might have ranked the analytical tools he used for his scientific studies against those he used for historical, theological, or alchemical questions.

The value of the papers Newton left behind has always depended on how—and whether—to link them together. While only a handful of people have ever seen the papers until very recently, news of their remarkable contents has leaked out into the public domain at intervals during the eighteenth, nineteenth, and twentieth centuries. The reactions they provoked have varied widely and tellingly, revealing changing attitudes toward the private nature of a public man. Against the icy perfection of his scientific achievements, Newton's madness, his meanness, and even his dullness have periodically been declaimed. The different Newtons that have been successively discovered in his writings tell a history not simply of how the life of one man has been reimagined in the nearly three hundred years since his death, but of the role of science, and scientists, in society more generally.

Once the more readily liquidated portion of Newton's estate—made up mostly of stock and annuities and totaling the staggering sum of about £30,000, the purchasing power of roughly $6 million today—had been shared out, the relatives agreed to release the papers to Catherine, Newton's half-niece and long-time housekeeper, and her husband, John Conduitt, who had assisted Newton in his role as Master of the Mint and who took up the position after him.

Catherine and John Conduitt wanted to secure Newton's reputation not only as a genius but also as a Christian. A cursory glance at his millions of words of religious writings had convinced them there was plenty of evidence of Newton's lifelong and exemplary Christian faith. The papers also made it clear that Newton believed Christianity had been corrupted in the fourth century by the insertion of the doctrine of the Trinity. For Newton, true Christianity did not exalt Christ as a full equal to God the Father. To orthodox Christians, including devout Anglicans like John and Catherine Conduitt, this was a serious heresy, and if it were made public that Newton defended it in writing, his papers would have caused a scandal, ruining his reputation as a scientist and statesman.

By keeping his beliefs secret and sufficiently adhering to the mainstream Christian rituals and rites to ward off undue suspicion, Newton had managed to lead a life of both quiet study and public service. In private, he contrived to practice his faith by scholarly means. By not leaving a will, Newton introduced an ambiguity into his legacy that may have been deliberate. He could leave the papers uncategorized and his wishes for them unstated, thereby protecting John and Catherine Conduitt from explicitly taking responsibility for the papers' unorthodox contents. This risky strategy left writings on which he had expended decades of work in limbo until a time when future generations might be able to appreciate the truths they contained. The chances were high that the papers would be lost, destroyed, or prematurely published. But Newton was lucky. The papers remained protected by the bonds of family and friendship, by secrecy and sheer neglect.

True to their desire to celebrate the memory of their famous relative, John and Catherine Conduitt helped to create the image of a mythic Newton blessed with almost divine insight and a Christian faith of almost saintly purity to go with it. They had done so by keeping his papers largely private and by publicly promoting Newton as a monument to pious science. The man himself—imperfect, surprising, self-contradicting—faded from sight.

When John and Catherine died, their daughter Kitty inherited the papers. She married into the aristocratic Portsmouth family, who continued to keep the manuscripts almost entirely hidden away at the family seat in Hampshire, Hurstbourne Park. The secrets they contained remained all but unknown for the rest of the eighteenth century.

Facing Uneasy Facts

But in the nineteenth century came a passion for uncovering the past. Digging up the dead and their paraphernalia was all the craze. What had lain quiet for a century was beginning to be disturbed by the scientific spirit of the age, which sought objectivity in history and biography no less than in physics and astronomy. New facts about Newton began to emerge, and what they revealed about the great scientist was not always flattering.

The archival material gradually but inexorably appearing in the beginning of the nineteenth century challenged what had for three generations become the comfortable image of Newton and produced new reasons for studying his life and personality. Rather than resting secure in his status as Britain's scientific saint, Newton became a subject for

vigorous debates over the relationship between intellectual achievement and morality. "Was he a *good man*," asked a child in one popular text, "as well as a great philosopher?" Given the preoccupation of the Romantic generation with "genius" and its psychological aspects, it was fitting that interest in Newton during the period would focus initially not on his religious beliefs (though anti-Trinitarianism retained the power to shock many Christians) but on his character and state of mind.

In the early 1820s, the Frenchman Jean-Baptiste Biot wrote a short biographical sketch of Newton, later published in English as "Life of Sir Isaac Newton." Biot presented evidence (drawn not from the Portsmouth papers but from a letter by one of Newton's contemporaries) that Newton had experienced a mental breakdown in 1692, just a few years after finishing the *Principia*. This event, suggested Biot, cleaved Newton's life in two. The first half was sane, rational, and scientific; it was the source of Newton's great discoveries and his signature scientific achievements. The second half of Newton's life, Biot argued, was mad, irrational, and religious, paling in comparison to the intellectual heights of his early years. Madness and piety formed close bedfellows in the Frenchman's telling, and for some British defenders of Newton the implication was tantamount to an attack against Britain and its greatest thinker. Biot's writing inspired both supporters and critics of Newton to dig deeper for more evidence with which to interrogate Newton's reputation.

Francis Baily, a former banker-turned-astronomical calculator and historian of science, joined the fray. He published a set of letters between Newton, the astronomer Edmond Halley, the Astronomer Royal John Flamsteed, and others concerning Flamsteed's enormous *Historia Coelestis Britannica* (*British Catalogue of Stars*). Newton had hoped that his own theory of the moon's orbit would be buttressed by Flamsteed's meticulous observations and records. The letters showed that, eager to see his theory confirmed, Newton had deviously forced publication of the incomplete *Catalogue* against Flamsteed's wishes, lying and abusing his power as President of the Royal Society to do so. (Flamsteed managed to destroy three hundred of the four hundred copies published. But a completed version of his *Catalogue* was not released until after his death.) It was hard to argue with the evidence for Newton's unscrupulous behavior. Baily also managed to gain access to the Newton papers at Hurstbourne Park and duly reported that he had found nothing there to contradict the picture of Newton as a vindictive, occasionally vicious man.

Newton found his greatest defender in David Brewster, a physicist, popularizer of science, and leader in the push to create a secure institutional

basis for science in the nation. Brewster was aghast at Biot's and Baily's representations of his hero as both mad and bad. He sought access to the papers at Hurstbourne in order to set the record straight, as he saw it. But while he eventually managed to get access to the papers, what he found was incontrovertible evidence that Newton had in fact been an anti-Trinitarian. Brewster found himself in a terrible bind. Committed to the values of a newly "scientific" history, in which primary documents would allow the public to make their own judgments, Brewster grappled with material that directly contradicted his own beliefs and his wishes for how Newton would be remembered. In his two-volume 1855 biography of Newton, he published as little of this as he could get away with and performed rhetorical gymnastics in order to avoid admitting the truth outright: that Newton had held heretical views.

A "Lengthy and Laborious Business"

By the mid-nineteenth century Newton had become subject to the same energetic, self-searching spirit that stimulated so much Victorian progress. Students of all things Newton were increasingly aware that evidence alone could not generate increased certainty. For many, the future seemed to promise only new kinds of questions and growing alienation from what had once seemed certain and sacred. A nationwide housecleaning accompanied this new quest for self-questioning. Books and papers that had been housed for centuries in the homes of aristocratic families such as the Portsmouths were catalogued and collected by the Royal Commission on Historical Manuscripts. Prompted perhaps by this Commission, in 1872 Isaac Newton Wallop, the 5th Earl of Portsmouth, generously donated the scientific portion of the Newton papers held by his family to Cambridge University, where Newton had studied and taught. The university appointed a committee—including an astronomer, a physicist, a historian, and a chemist—to catalogue the material and to separate the scientific from the non-scientific (which Lord Portsmouth had stipulated be returned to Hurstbourne Park as a proud emblem of the family's association with Newton).

At Cambridge, Newton was not only a patron saint but a pedagogical ancestor. He had provided the all-encompassing set of theories that still served as a comprehensive framework for undergraduate education in the sciences as late as the 1870s. The chance to understand the inner workings of Newton's mind through his papers had the potential to deepen and extend a system at Cambridge built in his image.

Newton had been famously coy about his own methods, suggesting that he had kept private his true means of discovering the laws of motion and gravitation put forth in the *Principia*, and had only publicly cast them in the language of geometry. The question was therefore whether he adhered to the rigorous, manly, and above all morally upright techniques of thinking that Cambridge undergraduates were coached to acquire. To answer this the committee was forced to consider whether Newton himself should—or could—be held accountable to the techniques that were mastered in his name. The Newton papers had the potential to probe more deeply the shadowy divide between patient work and divine inspiration, each of which had at times been stressed as chiefly responsible for Newton's scientific genius.

It took sixteen years to produce a terse catalogue of all the material, both scientific and non-scientific. The committee reported somewhat defensively that it had been a "lengthy and laborious business" to sort out the papers, confused as the documents were. Among other things they had found evidence of Newton's extraordinary burst of creativity during the plague years of 1665–1666, when he retreated to the relative safety of his family home and began the process of discovery that led to the binomial theorem, the calculus, and a theory of orbital motion. Newton himself characterized this time of enormous creativity, when he "minded Mathematicks & Philosophy more then at any time since," as solitary and intense. Whatever pedagogical regimen he had been exposed to at Cambridge, Newton did not credit it with enabling the discoveries, which he had begun to make not in his university rooms but in his childhood home, deep in the Lincolnshire countryside. So far, the papers seemed to prove that Newton's saint-like devotion and visionary abilities did not constitute anything approaching a pedagogical method that others might follow.

The papers did, however, offer a few tantalizing and illuminating tidbits on the question of method. Among the papers on the lunar theory, though they were damaged by fire and damp, enough was preserved to give a general sense of his thinking. There was evidence, in his calculations for determining how the relative motions of the sun and the earth perturbed the moon's orbit, that he had changed his mind after reaching an unsatisfactory determination of the equation that described the lunar apogee (the point at which the moon was furthest from the earth). The evidence suggested that Newton had indeed worked by a process of refinement that inevitably included false starts and error. In this sense, Newton revealed himself to be less an otherworldly genius and more a figure with

whom the Cambridge students could identify, a tireless worker in the mathematical trenches, where progress was made by increments, rather than leaps.

While there was much of interest to be found in Newton's scientific notes, the remaining papers on non-scientific subjects were, after sixteen years, given a summary dismissal. "Newton's manuscripts on Alchemy are of very little interest in themselves," the committee reported, being little more than transcripts of other authors' works, with the exception of the notes of his own chemical experiments. But, the committee suggested, Newton had failed to accomplish what it seemed he had set out to do: to trace a coherent system of chemical relationships from the morass of material he had gathered.

Similarly, the committee declared that the historical and theological papers "cannot be considered of any great value." The sheer mass of papers indicated that he had spent large parts of his later years "writing and rewriting his ideas on certain points of Theology and Chronology." They dismissed with an unconvincing argument Newton's wealth of expression in often composing multiple drafts, saying that he had been captivated by the charm of his own handwriting. It was too much to consider that Newton might have intended all these works, even those on the Apocalypse and the early history of the Church, to be read eventually by others.

In the care with which Newton had prepared his theological work the committee saw damning evidence of banality. The committee's judgment was, implicitly, a statement about the kind of thinking they believed the manuscript record should reflect. Cambridge students had been expressly trained to think with their pens in hand. Their examination papers recorded every step of their thought processes. Newton's theological papers were disconcertingly profuse but also, unlike those exam papers, suspiciously clean. They betrayed at once an unseemly obsession and a sterile neatness.

Gathering the Pieces

With the completion of the Cambridge committee's work in 1888, the scientific portion of Newton's papers finally became accessible to scholars. The committee had noted some of the papers' interesting features, but the catalogue had left much more to be discovered. Nevertheless, the papers, deposited in the Cambridge University library and freely available for the first time since Newton wrote them, sat practically unexamined for the

next sixty years. The irksome material on chronology, history, and theology was sent back to Hurstbourne Park, where it too remained largely unseen for another four decades.

It was a combination of personal financial difficulties and the broader economic crisis facing the aristocracy in the period between the two world wars that brought the remaining, non-scientific, papers before the public eye. In 1936, Gerard Wallop, the 9th Earl of Portsmouth (also known as Viscount Lymington), a descendant of Isaac Newton Wallop and inheritor of the material, decided to sell the non-scientific manuscripts at auction in order to meet death duties payable on the estate of his aunt as well as the costs of his impending divorce. Bidding at the sale was sedate. Gerard Wallop himself attended, and even bought back a few lots. The other bidders were professional book dealers and one additional private buyer. Not a single institutional buyer—no one from the libraries of Cambridge or the British Museum—came forward to try to keep the papers from being scattered to the four winds. The final price, for more than three hundred lots, was just over £9,000. Translating to approximately $700,000 today, it was a respectable but unspectacular amount. (Today a single sheet of manuscript in Newton's own hand on a scientific subject can bring up to $200,000.) As a token of the nation's esteem for its greatest scientist, it seemed to fall emotionally well short of the mark. Could not a national subscription have been raised to save the papers for the nation? Such a gesture had been forthcoming just a few years earlier, when the public had rallied to help raise £100,000 to purchase for the nation the *Codex Sinaiticus*, one of the oldest Greek versions of the Bible. Similarly, the National Maritime Museum had arranged for a number of Lord Nelson's belongings, including a silver sauce tureen, to be purchased for Britain. But now, with the threat of another world war looming, the nation had its mind on other matters, and other heroes, than the great scientist Isaac Newton.

Amidst the gloom, two men saw the glint of something valuable in the Newton papers on sale. One of them was the seemingly most unlikely of sorts to rescue the patrimony of England from an undignified scattering. He was Abraham Yahuda, a Jerusalem-born biblical scholar, philologist, and collector of manuscripts. He had missed the sale but quickly came to hear of the papers, and moved even more quickly to secure as many of them as he could. Their contents, bemusing to some, were stirring to Yahuda. He wrote to his wife about his purchases: "To have over 1500 pages written by Newton in his own hand on the most important questions is very thrilling indeed. But not only on Religion, Prophecies, Bibles, Faith, and

Chronology, but also on alchemy, Mathematics and other purely scientific matters of the greatest importance for his studies and discoveries!!" It was almost too much of a good thing, and Yahuda, who hurried down to Victoria Station to give a check to one of the dealers, would not "believe that I have the Mss. before I get them."

Just weeks after the sale, Yahuda was forming an appreciation of what the papers contained that went beyond what almost anyone else had understood about Newton. He immediately rejected the notion that Newton's non-scientific writings were worthless. Like Plato's philosophy or Ptolemy's geography, he explained, "the 'results' are antiquated but the work bears the stamp of Newton's genius and it will always have value." Yahuda had understood what many others had not: Newton's extensive religious writings, kept private for more than two hundred years since his death, were important in themselves as evidence of Newton's private faith and for the insight they could lend into his scientific genius.

The speed with which Yahuda came to this conclusion suggests that he must have been well-prepared to read the papers this way, but Yahuda himself felt that it was the papers that had changed him. "My occupation with Newton's papers have opened a new world to me and I am constantly under the spell of his personality," he confided to his wife. "In these times of crises and ordeal he exercises a calming and reassuring influence upon me." In 1936, there was great need for calm, and, especially for the Jews, for the support of an undisputed pillar of Western civilization. Yahuda perceived the redemptive potential of Newton's papers for the Jews, who could benefit from Newton's sympathy to their faith at a moment of terrible vulnerability. It was already very clear to Yahuda that among the outstanding secrets the papers revealed was that Newton himself was "more a monotheist than a Trinitarian."

The scholar invested quite heavily in the purchase of the Newton papers. Drawing on money from his wife's inheritance, he spent more than £1,400 (over $120,000 today) and sold some of his other manuscript stock to help fund the acquisitions. He didn't consider his acquisitions risky. The papers (he ended up, by his own estimation, with 3,400 folio pages) were the "best and most valuable" work he had ever purchased.

The other man who had realized as much could not have been more different from Yahuda in taste, habit, and social standing. He was John Maynard Keynes, the preeminent economist of his generation. Keynes's masterwork *The General Theory of Employment, Interest and Money* had been published just a few months earlier, further raising his reputation. What many who knew the public man did not realize was that Keynes was also

a passionate and committed collector of rare books. He attended the sale on a whim, after hearing about it at the last minute from his brother.

Keynes bought aggressively at the sale and even more so in the weeks afterward, as he became more and more impressed with the importance of the papers, and of keeping them together. He and Yahuda agreed to divide the lion's share of the lots, with Yahuda focusing on theology and Keynes on alchemy. The economist set out trying to understand more of what the mass of papers contained. This was no easy task. Most of the material consisted of Newton's notes on or copies of other alchemical writings, as well as anonymous treatises in unknown handwriting. It was hard to discern anything empirical, original, or finished in the mixed bag of documents. Keynes found the selection of material "exceedingly queer, most difficult to attribute to the same brain as that which produced his other works." And yet Newton had evidently taken care to keep these papers throughout his long life. There was something here that Newton thought worth substantial amounts of his time and worth saving for posterity. Despite his very busy life, Keynes found time to study this puzzle—and the papers—before he was forced to store them in cellars for safe-keeping when war broke out in 1939.

On the three-hundredth anniversary of Newton's birth, in 1942, despite the increasingly desperate position of Britain in the war, a day-long celebration of his life was held at the Royal Society. Keynes delivered an after-dinner talk, titled "Newton, the Man"—the basis of his better-known lecture by that title read by his brother almost four years later, after Keynes's death, at the Society's more elaborate tercentenary celebrations. In his talk, Keynes tried to come to grips with what he had discovered. His message was that Newton was not at all what he had been supposed to be. The ideal Newton—the one who had emerged in the eighteenth century as a cold-eyed rationalist—was in for a sharp revision. Like Biot and Baily before him, Keynes summoned up a private or secretive Newton, whose actions and beliefs were far from what might be expected of the idolized natural philosopher. Keynes's response to the theological and alchemical papers was not to dismiss them as befuddling and distracting but to propose a complete shift in the way Newton was understood, to describe Newton "*as he was himself*." It was not science that dominated Newton's worldview, argued Keynes, but a much older, more magical vision of the world as a union of connected parts.

But Keynes failed to appreciate fully his own insight into Newton's worldview. He concluded that this unorthodox side of Newton, though impossible to discount (the evidence was too strong) was simultaneously

impossible to credit. Keynes concluded that the theological papers were of "no substantial value whatever except as a fascinating sidelight on the mind of our greatest genius." Having come so far in his analysis, Keynes was content to let Newton exist as a kind of freak who combined in one body and one mind what Keynes thought of as the conflicting attributes of rational modernity and the occult pre-modern past. In this Keynes revealed the limits of his own imagination.

Newton Unbound

The 1936 sale sent Newton's non-scientific papers out into the world with little consideration for the value of his writings to the nation or to scholars. Luckily, the papers ended up in libraries where scholars can access them. Keynes bequeathed his papers to King's College, Cambridge, and Yahuda's manuscripts made their way to the Jewish National and University Library (now called the National Library of Israel). By 1960, the majority of the papers Newton had in his possession when he died in 1727 were finally available. For the protean discipline of the history of science, making sense of Newton's scientific and mathematical papers provided a focus and a sense of purpose during the 1960s and 1970s. More recently, scholars have begun to give serious attention to the alchemical and theological writings. Because of the diverse approaches to viewing Newton's complex life, he is emerging not as a unique and isolated genius but as a member of various and distinct communities: of alchemists, of radical Protestants, of Church historians.

The process of sorting out the papers continues today. Thanks to the large number of drafts and revisions, and the relative paucity of dates, it is a time-consuming endeavor that requires—often for a single manuscript page—a combination of specialist skills (paleographic, mathematical, historical) that few individuals possess. The notion of a fixed edition of Newton's papers, so long deferred, has further receded as the technology of the Internet enables digital editions to be continually updated and amended.

Curiously enough, the never-ending edition may be the most appropriate one of all for Newton's papers. Ultimately, as generations of scholars discovered, the papers will always remain unfixed and unstable. The manuscripts abound in revisions. More than any other comparable figure from the time, Newton was his own lifelong editor, constantly revising, deleting, and re-drafting across decades of study, as he was inspecting his own material in his search of deeper meaning within it. This was

both an effect and a cause of his undying aversion to publishing. By not publishing, Newton made it possible to continually revise what he wrote. Even publication did not mark the end of the process, as the extensive revisions between consecutive editions of the *Principia* and the *Opticks* indicate. Newton's practice of revision makes it very hard—perhaps impossible—to grasp the final meaning of his manuscripts because there is no final meaning to find, not least because of the devilish difficulty of fixing dates to so much loose material with only infrequent references to contemporary events. Time and again, an appetite for suffering appears among the list of qualifications for would-be editors of Newton's papers.

Only by embracing the dynamic nature of these papers, for the ways in which they record the active seeking in which Newton was engaged, do we see them for what they are: not a single story but a mass of intersecting stories. This kind of thinking veers into uneasy territory, where instability trumps fixed meaning and multiplicity beats singularity. It is an uncomfortable place to be. For some, it is also the only honest ground on which to stand.